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RECORDS OF MEETINGS.

Nine hundred and seventeenth Meeting.

MAY 9, 1900. — ANNUAL MEETING.

THE Academy met at the Jefferson Physical Laboratory, Cambridge.

VICE-PRESIDENT TROWBRIDGE in the chair.

A quorum not having been present at the adjourned stated meeting of April 11, 1900, on the motion of the Recording Secretary, it was

Voted, That the votes then proposed be now confirmed and approved.

The Corresponding Secretary read letters from Arlo Bates and L. H. Bailey, accepting Fellowship in the Academy. He also read a letter from Seabury C. Mastick, Secretary of the Committee on the Modification of the Federal Legacy Tax, enclosing a new petition intended as a substitute for the one sent out in January and requesting signatures. On the motion of the Recording Secretary, it was

Voted, That the President be authorized to sign this petition on behalf of the Academy.

The Chair announced the death of Frederick Edwin Church, Associate Fellow in Class III., Section 4.

The Annual Report of the Council was read by the Corresponding Secretary.*

The Treasurer presented his annual report, of which the following is an abstract: —

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* See Proceedings, XXXV. 623.

General Fund.

Receipts.

Balance from last year		$32.61
Investments	$5,649.80	
Assessments	915.00	
Admission fees	40.00	
Sale of publications	71.23	
Miscellaneous	6.30	6,682.33
		$6,714.94

Expenditures.

General expenses		$2,499.56
Publishing expenses		2,012.73
Library expenses	$1,161.77	
Expenses of moving	596.78	
Furniture	184.60	1,943.15
Balance		259.50
		$6,714.94

Rumford Fund.

Receipts.

Balance from last year		$3,915.10
Investments	$2,566.19	
Sale of publications	10.00	
Refund of appropriation	100.00	
Interest on bank account	71.82	2,748.01
		$6,663.11

Expenditures.

Investigations	$1,215.00	
Medals	327.00	
Library	81.28	
Miscellaneous	10.00	$1,633.28
Income invested during the year and transferred to capital account		3,253.90
Balance		1,775.93
		$6,663.11

Warren Fund.

Receipts.

Balance from last year		$1,149.43
Investments	$365.00	
Interest on bank account	50.27	415.27
		$1,564.70

Expenditures.

Investigations	$500.00	
Accrued interest on bonds purchased	70.13	$570.13
Balance		994.57
		$1,564.70

BUILDING FUND.

Receipts.

Balance from last year		$306.03
Investments	$240.00	
Income	21.55	261.55
		$567.58

Expenditures.

Accrued interest on bonds purchased	$28.06
Balance	539.52
	$567.58

The following reports were also presented: —

REPORT OF THE RUMFORD COMMITTEE.

At the last Annual Meeting of the Academy, the sum of $1000 was placed at the disposition of the Rumford Committee for the furtherance of researches in light and heat.

The Committee has made the following appropriations from this fund:

October 11, 1899, it was voted that an appropriation of $500 be made to Professor Edwin B. Frost of the Yerkes Observatory, to assist in the construction of a spectrograph especially designed for the measurement of stellar velocities in the line of sight.

January 10, 1900, it was voted that an appropriation of five hundred dollars be made to Professor Edward C. Pickering of Harvard College Observatory, for the purpose of carrying out an investigation on the Brightness of Faint Stars by coöperation with certain observatories possessing large telescopes.

Furthermore, on January 10, 1900, the Committee voted to ask the Academy to appropriate one hundred dollars from the income of the Rumford Fund to Professor Theodore W. Richards of Harvard University, for a research on the Transition Point of Crystallized Salts, which request was favorably acted upon by the Academy.

And on April 9, 1900, the Committee voted to ask the Academy to appropriate from the same source the sum of two hundred and fifty dollars to Mr. Arthur L. Clark of the Worcester Academy in furtherance of a research on the Molecular Properties of Vapors in the Neighborhood of the Critical Point. This recommendation has still to be acted upon.

The attention of the Committee had several times been called to the fact that for a long period of years there had been no way, except by a formal vote of the Academy, in which a person other than a member could purchase a copy of the Life and Works of Count Rumford. Meanwhile occasional applications from reputable persons or libraries had been received. The Committee therefore voted on April 9, 1900, to recommend to the Academy that the Treasurer be authorized to make arrangements for their sale to the public, intending that the whole matter of the manner of sale, price, and other details should be left to his discretion. Such authorization was duly granted by the Academy.

The Committee was furthermore advised that there is no copy of the Life and Works of Count Rumford in the Library of the Academy. It was therefore voted at the meeting of April 9, 1900, to recommend to the Academy that a set be added to the library.

At the same meeting it was voted, that the Committee recommend to the Academy the appropriation of one hundred and fifty dollars from the income of the Rumford Fund for the purchase and binding of the usual periodicals for the current fiscal year, together with the following: Deutsche Zeitschrift für Elektrotechnik, L'Éclairage Électrique, Fortschritte der Elektrotechnik.

It was also voted by the Committee that the Chairman recommend that the usual appropriation of one thousand dollars be made by the Academy for the immediate needs of the Committee in furtherance of research.

I have therefore to present the three last-mentioned recommendations for the consideration of the Academy.

The Committee has considered at much length the subject of an award of the Rumford Premium. Among the various candidates whose claims were discussed, there was one who without dissent was considered in the highest degree worthy of the honor. The numerous researches of Professor Carl Barus in various branches of heat, carried on for many years, have uniformly been characterized by great skill, accuracy, and originality, and these valuable contributions to science are generally recognized as of far-reaching importance.

It was unanimously voted by the Committee, for the first time on January 10, and for the second time on April 9, 1900, to recommend to the Academy at the Annual Meeting the award of the Rumford Medal to Professor Carl Barus, of Brown University, for his various researches in heat.

In response to the usual request, the Chairman of the Committee has received reports of progress from the following persons to whom grants have been made from the Rumford Fund: Professors H. Crew, E. B. Frost, G. E. Hale, E. H. Hall, F. A. Laws, E. L. Nichols, E. C. Pickering, B. O. Peirce, T. W. Richards, and W. C. Sabine.

These reports in full or in abstract are presented as an appendix to this Report.

Chas. R. Cross,
Chairman of the Rumford Committee.

APPENDIX.

Reports of Progress to the Rumford Committee.

May, 1900.

PROFESSOR HENRY CREW.

Grants of October 26, 1896, $400, for researches on the electrical, chemical, and thermal effects of the electric arc, and May 3, 1899, $200, for researches on the spectrum of the electric arc.

Referring to an "air-tight arc" which he has constructed, Professor Crew says, "This apparatus is well made, and works in a thoroughly satisfactory manner. With it I have made several series of photographs of the arc spectra of iron and magnesium, in an atmosphere of pure hydrogen. These plates I am now measuring up, and hope to be able to publish the results during the coming summer.

"Contrary to expectations, I do not find the iron spectrum at all simplified by the introduction of hydrogen. For while many lines are blotted out, many new ones are introduced by the hydrogen. No less than sixty-two iron lines, either new or profoundly modified, make their appearance between λ 2753 and λ 4415. The origin of these lines I have not yet succeeded in finding.

"I have spent some time also in trying to produce, in this arc, the hydrogen series discovered by Professor Pickering in the star Z Puppis; but I have not found anything resembling such a series."

PROFESSOR EDWIN B. FROST.

Grant of January 10, 1900, $500, to assist in the construction of a spectrograph, especially designed for the measurement of stellar velocities in the line of sight.

"In reply to your inquiry 'as to the present status of researches now in progress which have received aid from the Rumford Fund,' I would state that three remarkably fine prisms have already been purchased, and the other optical parts have been ordered, for the new spectrograph designed for the determination of stellar velocities in the line of sight, in aid of which research a grant of $500 was made last autumn.

"It is hoped that the spectrograph may be completed and the regular work with the instrument may be begun during the present summer, and I shall therefore expect to be able to announce some results of the investigations for your next annual meeting."

PROFESSOR GEORGE E. HALE.

Grant of November 10, 1897, $400, for the purpose of completing a spectroheliograph.

"The spectroheliograph was first attached to the 40-inch telescope last December. Preliminary tests in the laboratory had shown it to be extremely satisfactory from an optical point of view, at least in so far as the definition and contrast of the photographs of spectra were concerned. As we were without a skilled instrument maker at the observatory for several months last summer and autumn, I had the moving plate holder and second slit constructed by an instrument maker in Chicago. The first tests with the telescope showed the presence of a mechanical defect, which caused the plates to be striped with lines a millimeter apart, the pitch of the screw which drives the plate-carriage. A series of experiments showed that these lines were due in large part, if not altogether, to the absence of suitable end-thrust bearings for the screw, and to the poor construction of the screw, nut, plate-carriage, etc. It was then decided to completely reconstruct this part of the spectroheliograph in our own shop. End-thrust bearings were supplied, together with a new screw, which was carefully ground. As the result of the work the millimeter lines did not appear on the photographs taken after the change had been made. It was found, however, that the plate was still covered with fine lines about one quarter of a millimeter apart. These are shown on the plate which I will send you in a few days. In order to remove these lines a large number of experiments were required, but at last, plates practically free from lines, and even smoother than those obtained with the very satisfactory hydraulic apparatus of the Kenwood spectroheliograph, were secured. The difficulty was due in part to errors in the gears, and in part to the theoretically correct double Hooke's joint, which has now been replaced with a belt and pulleys.

"As may easily be imagined, the curvature of the spectral lines in this spectroheliograph is very marked. If the first slit is straight the second slit must be curved, to fit the K line, and the resulting image of the sun is seriously distorted. By dividing the curvature equally between the two slits, and moving the plate in a direction opposite to that employed with a straight first slit, the distortion can be wholly removed. You will notice that the images on the plate sent you are round.

"As soon as the eclipse work is over I hope to return to the spectroheliograph. The preliminary results are such as to lead me to expect much from the instrument."

PROFESSOR EDWIN H. HALL.

Grant of April 26, 1895, $250, in aid of his investigation on the thermal conductivity of metals.

"I expect to read by title a paper at the next meeting of the Academy. I am using some of the money on a side research carried on by Mr. McElfresh, a graduate student, on the thermo-electric effect of hydrogen occluded in nickel. Said effect seems thus far to be lacking."

PROFESSOR FRANK A. LAWS.

Grant of December 13, 1893, in aid of an investigation on the thermal conductivity of metals.

"In respect to the experiments on Thermal Conductivity I can say that this constant for the cast-iron specimen has been determined, and the result calculated. I have not published the method, for the calibration is not satisfactory to me on account of a very peculiar set of readings which I do not feel justified in rejecting. During the examination period I hope to straighten the matter out."

PROFESSOR EDWARD L. NICHOLS.

Grant of October 19, 1894, $250, in aid of investigations on the radiations from carbon at different temperatures.

"I beg to report that my investigation of the visible radiation from carbon, made in part by the aid received from the Rumford Fund, is nearing completion. Spectrophotometric comparisons of the light from the two varieties of carbon, black and gray, using as a standard the acetylene flame, have been made up to temperatures above 1600°. I am at present struggling with the more difficult range between 1600° and the melting point of platinum. The determination of the higher temperatures offers considerable difficulty as yet, but there are indications which make it seem worth while to carry the investigation to as high a point as possible. The research involves three subordinate investigations, one of which, on the temperatures of the acetylene flame itself, is completed. This I have made the subject of a paper read before the Physical Society. It is likewise printed in the April number of the Physical Review. In my report to the American Academy, I shall incorporate the results of these measurements in connection with the main subject. Of the other two subordinate researches, the study of the thermo elements employed is nearly completed, and a determination of the distribution of energy in the spectrum of the acetylene flame by means of the Nichols radiometer is in progress. The latter is being carried on by one of my assistants, Mr. G. W. Stewart, and we hope as a result of his measurements to obtain a study of the absolute values, by means of which spectrophotometric measurements for different wave lengths can be brought into known relations to each other.

"The work for which the grant was made from the Rumford Fund has required a much longer time than I anticipated, but in spite of the numerous difficulties which we have had to overcome, I think the end is now in sight."

PROFESSOR EDWARD C. PICKERING.

Grant of January 10, 1900, $500 for the purpose of carrying out an investigation on the Brightness of Faint Stars, by coöperation with certain observatories possessing large telescopes.

"An appropriation of five hundred dollars ($500) has been made from the Rumford Fund, to be expended under the direction of Professor Pickering, for the purpose of carrying out an investigation on the brightness of faint stars by coöperation with certain observatories possessing large telescopes. This appropriation results from a communication made to the Council of the American Astronomical and Astro-physical Society held in New York last January. It was represented that the most urgent need of astronomy in America was adequate endowment of the great telescopes of the country so that they could be kept actively at work. It was shown that while the two largest telescopes of the country, and of the world, were kept constantly at work, the means for the reduction and publication of the observations are wholly inadequate; while some of the largest telescopes in the country, representing a plant costing hundreds of thousands of dollars, are nearly idle and therefore useless. Observations of the greatest value can be obtained with these instruments at small expense, and it is hoped that the beginning now made will justify its permanent continuance on a large scale. The problem undertaken is the determination of the light of faint stars, selected as standards. These will furnish points of reference to which other photometric measures may be referred. Five photometers have been constructed in which, by interposing a photographic wedge of shade glass, an artificial star is reduced in brightness until it appears equal to a real star, as seen in a large telescope. Thirty-six regions have been selected in different parts of the sky, in each of which a series of standards is to be measured. Five stars of about the twelfth magnitude, five of the fifteenth, five of the sixteenth, and five of the seventeenth are to be chosen in each of these regions. The faintest stars will be selected and measured with the Yerkes 40-inch and Lick 36-inch telescopes. Those of the sixteenth magnitude will be measured with the 26-inch telescope of the University of Virginia and perhaps the Princeton 23-inch telescope. The stars of the fifteenth magnitude will be measured with the 15-inch Harvard telescope. All of these stars will be compared with the stars of the twelfth magnitude, when absolute magnitudes will be determined with the 12-inch Harvard meridian photometer. Their relative brightness will also be determined more accurately with the Harvard 15-inch telescope. After the work is fairly started it is believed that it can be reduced to a simple routine, by which great results may be attained with a moderate expenditure. By the time this report is presented, it is expected that observations with the Yerkes, Lick, University of Virginia, and Harvard telescopes will be in progress."

PROFESSOR B. O. PEIRCE.

Grant of December 2, 1892, $200, and April 26, 1895, in aid of an investigation on the propagation of heat in certain solid bodies.

Professor Peirce writes that he "published last summer in the Proceedings of the Academy a short paper on the 'Thermal Conductivity of Vulcanite,' giving therein the results of a long series of experiments. This paper in a somewhat extended form appeared in the Philosophical Magazine."

A paper on the specific heats of different marbles is also ready for publication.

PROFESSOR THEODORE W. RICHARDS.

Grants of October 12, 1898, $200, for the construction of a microkinetoscope, the immediate application of which is to be a study of the birth and growth of crystals; and January 10, 1900, $100, for a research on the transition point of crystallized salts.

"I have had the honor of receiving two grants from the Rumford Fund, the accounts of which have not been closed.

"The first was given for the study of crystal growth by instantaneous photography. Upon this research I have already made several reports. Having pushed the photographic study of the growth of crystals in aqueous solutions to the furthest limit which seemed possible without a very much greater expenditure of money, we have turned our attention to the study of the change of the crystalline structure of iron and steel at a red heat. We have been able so to modify our apparatus, with very slight extra expenditure, that such study seems to be possible.

"The second grant of money was for prosecuting a research on new fixed temperatures for thermometric standardization. Of this grant only $27.50 have thus far been spent for materials which have not yet been exhausted. We have succeeded in showing that the transition temperature of sodic chromate is very near 19.88°, but the exact point cannot be fixed until our thermometers have arrived from the Bureau internationale. These new thermometers are to be the property of the College, hence all the remainder of the Rumford grant ($100 — $27.50 = $72.50) will be available for the special purposes of this particular investigation."

PROFESSOR WALLACE C. SABINE.

Grants of January 12, 1898, $400, and March 15, 1899, $200, for researches on ultra-violet radiation.

Professor Sabine states that Mr. Lyman, who is engaged upon the investigation, "will publish a paper on a by-product of the investigation which seems to me very interesting and important. In this paper he proposes to show that among the spectra formed by the Rowland concave gratings there are spectra not accounted for by the ordinary theory of the grating; that such spectra are common, and at times fairly strong and of excellent definition; that these spectra are diffraction spectra of much less dispersion than the ordinary recognized spectra, and that the errors of ruling to which they are due are not local but general to the whole surface of the grating He will also explain an experimental method of sorting out these lines from the regular and calculable spectra.

These false spectra are especially dangerous in series spectra work, giving a somewhat systematic reproduction of strong lines and groups, which in actual vibration frequencies do not exist. There is some evidence that such errors have been committed in the past, and it was in the presence of such errors that the false spectra were here discovered."

REPORT OF THE C. M. WARREN COMMITTEE.

In behalf of the C. M. Warren Committee, I have to report that Professor Mabery, to whom a grant of $500 was voted by the Academy at the last Annual Meeting, has vigorously prosecuted his researches on the Composition of Petroleums. During the year he has published also several papers describing the results of his earlier researches which were aided by previous grants from the Warren Fund.

Professor H. O. Hofman, to whom grants, amounting in all to $230, were made several years ago, has in this year published the results of his work in a memoir entitled "The Temperatures at which Certain Ferrous and Calcic Silicates are formed in Fusion, and the Effect upon these Temperatures of the Presence of Certain Metallic Oxides."

The C. M. Warren Committee recommends that the sum of six hundred dollars ($600) from the income of the Cyrus M. Warren Fund be granted to Professor Charles F. Mabery, of Cleveland, Ohio, for the continuation of his researches on the Chemistry of Petroleums.

F. H. STORER, *Chairman.*

9 MAY, 1900.

REPORT OF THE COMMITTEE OF PUBLICATION.

The Publishing Committee reports that during the past academic year there have been issued three numbers of Vol. XXXIV. and twenty-two numbers of Vol. XXXV. of the Proceedings, aggregating 579 pages, with no plates. One number only has been printed at the charge of the Rumford Fund. The expenditure from the General Fund was $2,012.93, out of an available amount from appropriation and sales of $2,471.23, leaving an unexpended balance of $458.30. The Committee desires for the coming year the same appropriation as for the last, viz., $2,400.

For the Committee,

SAMUEL H. SCUDDER, *Chairman.*

REPORT OF THE COMMITTEE ON THE LIBRARY.

The most important feature of the year was the removal of the Library from the Boston Athenæum building to the third story of the new building of the Massachusetts Historical Society. Although it was expected that these quarters would be ready in April, 1899, it was six months later before they could be occupied. The books, etc., were moved in good order between October 17 and November 7, 1899, thanks to the careful supervision of Dr. Holden, the Assistant Librarian. The opportunity was taken to send to the binder many volumes which had accumulated from previous years. The storage-room in the basement of the new building could not be occupied until April, 1900, and during the first week of that month the publications of the Academy, which had been stored in the basement of the Athenæum, were brought there.

The accessions during the year have been as follows: —

	Vols.	Parts of vols.	Pams.	Maps.	Total.
By gift and exchange	431	1687	328	5	2451
By purchase — Gen'l Fund	25	593			618
By purchase — Rumf. Fund		155			155
Total	456	2435	328	5	3224

The total number compares with 3284 during the previous year.

25 volumes and 593 parts of volumes were bought with the appropriation from the income of the General Fund at an expense of $191.35. 155 parts of volumes were bought with an appropriation from the income of the Rumford Fund for $24.28.

449 volumes were bound at an expense of $504.55, of which $487.00 was charged to the General Fund, and $17.05 to the Rumford Fund.

202 books have been borrowed by twenty-five persons, including eighteen Fellows of the Academy. 155 of these volumes were borrowed between May and October, 1899, and only 47 between November, 1899, and May, 1900. 22 volumes were not returned before May 2nd, in accordance with the rule. It will be noticed that the use of the Library has much diminished during the past six months. During the preceding year 235 volumes were borrowed.

Of the appropriation from the General Fund of $1500, $1161.77 has been spent. This includes $479.74 for incidental expenses of the Assistant Librarian, but does not include about $200 for subscriptions to periodicals not yet paid and about $100 for books now in binders' hands. It is therefore hoped that the unexpended balance of the $1500, viz. $338.23, may be reappropriated for next year, making a total of $1838.23.

The appropriation from the Rumford Fund was $120, of which only $41.33 has been spent, $17.05 for binding and $24.28 for periodicals, but subscriptions to periodicals aggregating about $65, and some binding must still be paid for. Therefore it is desired that the balance of the appropriation, viz. $78.67, be reappropriated for next year in addition to the $150 recommended by the Rumford Committee. The volumes needed to complete the file of the "Fortschritte der Physik," which it was voted to purchase, have been ordered.

The cost of moving the Library and belongings, which it was voted to pay from the funds of the Academy, was $601.78.

Of the special appropriation of $200 for furnishing the Library, $184.60 has been spent. This includes $30 for the purchase of a typewriter which has been useful to the Recording Secretary as well as to the Assistant Librarian.

In conclusion, the need of a new catalogue of the Library is urged. At present there is only an author-catalogue written on inconveniently large cards, and the writing is often nearly illegible. So valuable a library demands a modern catalogue of authors and subjects, either typewritten or printed on standard cards. The cost of such a catalogue is not known, but a special appropriation of $200 is asked for, to commence the work.

A. LAWRENCE ROTCH,
Librarian, and Chairman Committee
on the Library.

BOSTON, MAY 9, 1900.

In accordance with the recommendations contained in the above reports, it was

Voted, To award the Rumford Medal to Carl Barus, for his various researches in heat.

Voted, That a set of the Life and Works of Count Rumford be added to the Library of the Academy.

Voted, To appropriate one hundred and fifty dollars ($150) from the income of the Rumford Fund for the purchase and binding of the usual periodicals for the current fiscal year, together with the following: Deutsche Zeitschrift für Elektrotechnik, L'Éclairage Électrique, and Fortschritte der Physik.

Voted, That the sum of one thousand dollars ($1000) from the income of the Rumford Fund be placed at the disposal of the Rumford Committee to be expended in aid of investigations on light and heat, payments to be made on the order of the Chairman of the Committee.

Voted, That an appropriation of six hundred dollars ($600) from the income of the Warren Fund be granted to Charles F. Mabery of Cleveland, Ohio, for the continuation of his researches on the chemistry of petroleum.

Voted, To appropriate twenty-four hundred dollars ($2400) from the income of the General Fund for the expenses of publication.

Voted, To appropriate eighteen hundred and thirty-eight and $\frac{23}{100}$ dollars ($1838.23) from the income of the General Fund and two hundred and twenty-eight and $\frac{67}{100}$ dollars ($228.67) from the income of the Rumford Fund, in addition to the amount recommended by the Rumford Committee, for library expenses.

Voted, to appropriate two hundred dollars ($200) toward making a new catalogue of the Library.

On the recommendation of the Committee of Finance, it was

Voted, To appropriate two thousand dollars ($2000) from the income of the General Fund for general expenses.

Voted, That the assessment for the ensuing year be five dollars.

On the motion of S. H. Scudder, it was

Voted, To meet on adjournment on the second Wednesday in June.

The annual election resulted in the choice of the following officers and committees: —

ALEXANDER AGASSIZ, *President.*
JOHN TROWBRIDGE, *Vice-President for Class I.*
ALPHEUS HYATT, *Vice-President for Class II.*
AUGUSTUS LOWELL, *Vice-President for Class III.*
WILLIAM M. DAVIS, *Corresponding Secretary.*
WILLIAM WATSON, *Recording Secretary.*
FRANCIS BLAKE, *Treasurer.*
A. LAWRENCE ROTCH, *Librarian.*

Councillors.

Henry Taber,
Theodore W. Richards, of Class I.
Harry M. Goodwin,

William T. Councilman,
John E. Wolff, of Class II.
George H. Parker,

James B. Ames,
William Everett, of Class III.
A. Lawrence Lowell,

Member of the Committee of Finance.

Augustus Lowell.

Rumford Committee.

Erasmus D. Leavitt, Amos E. Dolbear,
Edward C. Pickering, Arthur G. Webster,
Charles R. Cross, Theodore W. Richards,
Thomas C. Mendenhall.

C. M. Warren Committee.

Charles L. Jackson, Leonard P. Kinnicutt,
Samuel Cabot, Arthur M. Comey,
Henry B. Hill, Robert H. Richards,
Henry P. Talbot.

The following gentlemen were elected members of the Academy: —

Jay Backus Woodworth, of Cambridge, as Resident Fellow in Class II., Section 1 (Geology, Mineralogy, and Physics of the Globe.)

Merritt Lyndon Fernald, of Cambridge, as Resident Fellow in Class II., Section 2 (Botany).

William Ernest Castle, of Cambridge, as Resident Fellow in Class II., Section 3 (Zoölogy and Physiology).

George Mercer Dawson, of Ottawa, as Associate Fellow in Class II., Section 1 (Geology, Mineralogy, and Physics of the Globe), in place of the late Sir John William Dawson.

Melville Weston Fuller, of Washington, as Associate Fellow in Class III., Section 1 (Philosophy and Jurisprudence).

Rufus Byam Richardson, of Athens, as Associate Fellow in Class III., Section 2 (Philology and Archaeology).

Thomas Day Seymour, of New Haven, as Associate Fellow in Class III., Section 2.

Henry Morse Stephens, of Ithaca, as Associate Fellow in Class III., Section 3 (Political Economy and History).

William Cawthorne Unwin, of London, as Foreign Honorary member in Class I., Section 4 (Technology and Engineering).

Sir Archibald Geikie, of London, as Foreign Honorary Member in Class II., Section 1 (Geology, Mineralogy, and Physics of the Globe), in place of the late Carl Friedrich Rammelsberg.

Sir John Murray, of Edinburgh, as Foreign Honorary Member in Class II., Section 1, in place of the late Alfred Louis Olivier Legrand Des Cloizeaux.

Arthur G. Webster called attention to the bill before the House of Representatives for the establishment of a National Standardizing Bureau, and on his motion, it was

Voted, That the Academy approves this project.

On the motion of W. M. Davis, it was

Voted, That the committee appointed at the meeting of April 11, 1900, to consider the propriety of amending the first chapter of the Statutes be instructed to correct certain clerical errors in the Statutes.

Clarence J. Blake made some remarks on the scientific researches of his father, the late John H. Blake, which he intended to describe more fully in a forthcoming biographical notice.

John Trowbridge described some results obtained with a storage battery of twenty thousand cells and exhibited the battery in operation.

Experiments on the passage of powerful discharges through minute orifices were described, and proofs of the oscillatory nature of sparks six feet long were given. Since these sparks closely represent the main features of lightning, it is probable that most lightning discharges are also oscillatory. The battery with the aid of large condensers furnishes powerful quantity discharges which are more interesting from a scientific point of view than discharges of high electromotive force; for a new field appears to be opened in spectrum analysis. Photographs of the spectra of gases can be obtained with one or two discharges with a narrow slit.

Perhaps the most interesting results obtained with the battery were from the methods of exciting the X-rays. Photographs of the usual subjects treated by these rays can be taken, and they exhibit great contrasts; moreover, there are traces of ligaments and muscles as well as bones. The members of the Academy visited the battery room and saw a hydrogen tube excited by the discharge from three hundred Leyden jars, and the lighting of an X-ray tube.

The following papers were presented by title: —

Paleontological Notes V. A New Fossil Crab from the Miocene Greensand Bed of Gay Head, Martha's Vineyard, with Remarks on the Phylogeny of the Genus Cancer. By Alpheus S. Packard.

On the Thermal Diffusivities of Different Kinds of Marble. By B. O. Peirce and R. W. Willson.

Paleontological Notes VI. On Supposed Merostomatous and Other Paleozoic Arthropod Trails, with Notes on those of Limulus. By Alpheus S. Packard.

On the Continuity of Groups generated by Infinitesimal Transformations. By S. E. Slocum. Presented by Henry Taber.

On the Thermal and the Electrical Conductivity of Soft Iron. By Edwin H. Hall.

An Apparatus for Recording Alternating Current Waves. By Frank A. Laws.

The Dinitro Compounds of Paradibrombenzol. By C. Loring Jackson and D. F. Calhane.

On Certain Derivatives of Orthobenzoquinone. By C. Loring Jackson and Waldemar Koch.

Geometry on Ruled Quartic Surfaces. By F. B. Williams. Presented by W. E. Story.

On the Action of Sodic Sulphite on Tribromdinitrobenzol and Tribromtrinitrobenzol. By C. Loring Jackson and Richard B. Earle.

Nine hundred and eighteenth meeting.

JUNE 13, 1900. — ADJOURNED ANNUAL MEETING.

A quorum was not present and the Academy was not called to order.

Nine hundred and eighteenth Meeting.

OCTOBER 10, 1900. — STATED MEETING.

The CORRESPONDING SECRETARY in the chair.

The following letter was read: —

843 EXCHANGE BUILDING, BOSTON,
September 5, 1900.

FRANCIS BLAKE, ESQ.,
Treasurer of the American Academy of Arts and Sciences.

DEAR SIR, — By a letter enclosed in his will, my Father, Mr. Augustus Lowell, requested his sons to pay "to the American Academy of Arts and Sciences $10,000." It gives me great pleasure to enclose to you, in accordance with this request, a check for the amount named.

Very truly yours,
A. LAWRENCE LOWELL.

The Corresponding Secretary also read letters from W. E. Castle, M. L. Fernald, Jeremiah Smith, and J. B. Woodworth, accepting Fellowship; from George M. Dawson, M. W. Fuller, T. D. Seymour, and H. M. Stephens, accepting Associate Fellowship; and from Sir Archibald Geikie, F. Kohlrausch, Sir John Murray, and W. C. Unwin, acknowledging election as Foreign Honorary Members.

Announcement was received of the death of D. T. Day, formerly President of the Buffalo Society of Natural Sciences.

The following deaths were announced: —

Augustus Lowell, Vice-President for Class III.; John Elbridge Hudson, of Class III., Section 1., Sylvester R. Koehler, of Class III., Section 4, Resident Fellows; James Edward Keeler, of Class I., Section 1, Jacob Mandes DaCosta, and Alfred Stillé, of Class II., Section 4, William Mitchell, of Class III., Section 1, Associate Fellows; Willy Kühne, of Class II., Section 4, Charles Russell, Baron Russell of Killowen, and Henry Sidgwick, of Class III., Section 1, Foreign Honorary Members.

The Chair appointed the following standing committees: —

Committee of Publication.

SAMUEL H. SCUDDER, SETH C. CHANDLER,
CRAWFORD H. TOY.

Committee on the Library.

A. LAWRENCE ROTCH, HENRY W. HAYNES,
SAMUEL HENSHAW.

Auditing Committee.

HENRY G. DENNY, WILLIAM L. RICHARDSON.

The Chair appointed from the next retiring Councillors

THEODORE W. RICHARDS, of Class I.,
WILLIAM T. COUNCILMAN, of Class II.,
JAMES B. AMES, of Class III.,

a committee to nominate candidates for the offices made vacant by the death of Augustus Lowell.

Thomas Messenger Drown, of South Bethlehem, was elected an Associate Fellow in Class I., Section 3 (Chemistry).

J. H. Wright gave an account of "Recent Excavations in Crete," by Miss Helen S. Boyd, of the American School at Athens.

Barrett Wendell read an essay on the "Literary History of America."

W. M. Davis presented some "Geographical Notes on Brittany and Devonshire."

The following paper was presented by title by W. C. Sabine: —

False spectra from the Rowland Concave Grating. By Theodore Lyman.

Nine hundred and nineteenth Meeting.

NOVEMBER 14, 1900.

The CORRESPONDING SECRETARY in the chair.

The Corresponding Secretary read a letter from the American Chemical Society transmitting resolutions relative to the establishment of a National Standards Bureau in connection with the United States Office of Standard Weights and Measures and requesting coöperation in its efforts to secure the establishment of such bureau.

On the motion of Arthur G. Webster, it was

Voted, That this matter be referred to a committee to be appointed by the Chair.

The committee was constituted as follows: —

JAMES M. CRAFTS, *Chairman*,
ARTHUR G. WEBSTER,
THEODORE W. RICHARDS,
EDWIN H. HALL.

On the motion of Barrett Wendell, the following resolution was adopted: —

Whereas, The Academy has received the sum of ten thousand dollars paid by the sons of the late Augustus Lowell at the request of their father, therefore be it

Resolved, That the Academy accepts this gift with grateful appreciation of the generosity of its late honored Vice-President, and that the Corresponding Secretary notify this action to Mr. Lowell's sons.

The following papers were presented by title: —

On the Composition of California Petroleum. By Charles F. Mabery and Edward J. Hudson.

On the Chlorine Derivatives of the Hydrocarbons in California Petroleum. By Charles F. Mabery and Otto J. Sieplein.

On the Composition of Japanese Petroleum. By Charles F. Mabery and Shinichi Takano.

James Ford Rhodes read an account of "Sherman's March to the Sea," of which the following is an abstract: —

After the capture of Atlanta, the question in Sherman's mind was how he should still further proceed on the offensive. Hood gave him trouble by severing his communications, but he could not be brought to a battle, nor could he be caught in a pursuit. Sherman resolved to leave Tennessee in the care of Thomas and march through Georgia to the sea. He severed his communications with the North, November 12, 1864, and from that day to December 14 no direct intelligence from him reached the North. There was little fighting, but the supply of 62,000 troops in the enemy's country called for foresight and system on the part of the general; to prevent the host from degenerating into a lawless mob required the enforcement of discipline by the general and his officers. The army foraged liberally on the country in an orderly manner. While there were some abuses, some wanton destruction of property, and some pillage, there were no cases of murder or rape. On the whole the army behaved as well as could have been expected. Sherman estimated the damage done to the State of Georgia at $100,000,000. On the night of December 20, 1864, the Confederates evacuated Savannah, Sherman took possession of the city, and sent his celebrated Christmas-gift despatch to President Lincoln.

H. Helm Clayton read a paper entitled: "The Eclipse Cyclone and the Diurnal Cyclone: Results of Meteorological Observations during the Solar Eclipse of May 28, 1900."

Nine hundred and twentieth Meeting.

DECEMBER 12, 1900.

The Academy met at the house of William W. Jacques.

The PRESIDENT in the chair.

The death of Thomas Gaffield, Resident Fellow in Class I., Section 3, was announced.

On the motion of the Corresponding Secretary, it was

Voted, That a committee be appointed to make revision of certain passages in the Statutes and report thereon to the Academy.

This committee was constituted as follows: —

The PRESIDENT,
The CORRESPONDING SECRETARY,
C. LORING JACKSON.

Wallace C. Sabine spoke on "The Influence of Architecture on Melody and the Development of the Musical Scale."

John E. Wolff described the celebration of the two-hundredth anniversary of the foundation of the Royal Academy of Sciences, at Berlin, on the 19th and 20th of March last, which John W. White and himself attended as delegates from the American Academy.

William Everett gave an account of the life and works of the late Henry Sidgwick, referring particularly to his eminent ability and estimable character.

The following paper was read by title: —

"Symmetrical Triiodbenzol." By C. Loring Jackson and G. E. Behr.

Nine hundred and twenty-first Meeting.

JANUARY 9, 1901. — STATED MEETING.

VICE-PRESIDENT HYATT in the chair.

On the motion of C. L. Jackson, it was

Voted, To defer action on the proposed amendments of the Statutes.

Voted, That the Academy send a message of congratulation to Vladimir Markovnikoff, of Moscow, on the occasion of the 40th anniversary of his work on chemistry.

The vacancies occasioned by the death of Augustus Lowell were filled by the election of

JAMES B. THAYER, *Vice-President for Class III.*

ELIOT C. CLARKE, *Member of the Committee of Finance.*

Denman W. Ross read a paper entitled, "Design as a Science."

S. C. Chandler gave an account of his "New Discovery concerning the Motion of the Earth's Pole."

The following papers were presented by title: —

" Suggestion concerning the Nomenclature of Heat Capacity." By T. W. Richards.

" A Study of Growing Crystals by Instantaneous Photomicrography." By T. W. Richards and E. H. Archibald.

Nine hundred and twenty-second Meeting.

FEBRUARY 13, 1901.

The CORRESPONDING SECRETARY in the chair.

The Chair announced the death of Charles Hermite, Foreign Honorary Member in Class I., Section 1.

An invitation to the Ninth Jubilee Celebration of the University of Glasgow was read. On the motion of the Recording Secretary, it was

Voted, That the Academy send delegates to this celebration.

A circular inviting attendance at the Fifth International Congress of Physiologists was read; also, a letter from James B. Thayer, acknowledging his election as Vice-President for Class III.

The following paper was read by title: —

"A Study of Variation in the Fiddler Crab (Gelasimus pugilator Latr.)" By Robert M. Yerkes. A Contribution from the Zoölogical Laboratory of the Museum of Comparative Zoölogy at Harvard College. Presented by E. L. Mark.

Nine hundred and twenty-third Meeting.

MARCH 13, 1901. — STATED MEETING.

VICE-PRESIDENT HYATT in the chair.

The following deaths were announced: —

Charles Carroll Everett, Resident Fellow in Class III., Section 1.

George Mercer Dawson, Associate Fellow in Class II., Section 1.

The following gentlemen were elected members of the Academy: —

Alexander Wilmer Duff, of Worcester, as Resident Fellow in Class I., Section 2 (Physics).

Theodore Lyman, of Brookline, as Resident Fellow in Class I., Section 2.

Lewis Jerome Johnson, of Cambridge, as Resident Fellow in Class I., Section 4 (Technology and Engineering).

Henry Lloyd Smyth, of Cambridge, as Resident Fellow in Class I., Section 4.

Frank Shipley Collins, of Malden, as Resident Fellow in Class II., Section 2 (Botany).

Ephraim Emerton, of Cambridge, as Resident Fellow in Class III., Section 3 (Political Economy and History).

Frank William Taussig, of Cambridge, as Resident Fellow in Class III., Section 3.

Eliakim Hastings Moore, of Chicago, as Associate Fellow in Class I., Section 1 (Mathematics and Astronomy).

George Ellery Hale, of Williams Bay, as Associate Fellow in Class I., Section 2 (Physics).

Edward Leamington Nichols, of Ithaca, as Associate Fellow in Class I., Section 2, in place of the late William Augustus Rogers.

Cyrus Guernsey Pringle, of Charlotte, Vermont, as Associate Fellow in Class II., Section 2 (Botany), in place of the late George Clinton Swallow.

Franklin Paine Mall, of Baltimore, as Associate Fellow in Class II., Section 3 (Zoölogy and Physiology), in place of the late Alfred Stillé.

Henry Fairfield Osborn, of New York, as Associate Fellow in Class II., Section 3, in place of the late Othniel Charles Marsh.

Charles Otis Whitman, of Chicago, as Associate Fellow in Class II., Section 3.

William Stewart Halsted, of Baltimore, as Associate Fellow in Class II., Section 4 (Medicine and Surgery), in place of the late William Alexander Hammond.

William Williams Keen, of Philadelphia, as Associate Fellow in Class II., Section 4, in place of the late Jacob Mandes Da-Costa.

Jules Henri Poincaré, of Paris, as Foreign Honorary Member in Class I., Section 1 (Mathematics and Astronomy), in place of the late Francesco Brioschi.

Heinrich Müller-Breslau, of Berlin, as Foreign Honorary Member in Class I., Section 4 (Technology and Engineering).

Hugo Kronecker, of Bern, as Foreign Honorary Member in Class II., Section 3 (Zoölogy and Physiology), in place of the late Willy Kühne.

Sir Thomas Lauder Brunton, of London, as Foreign Honorary Member in Class II., Section 4 (Medicine and Surgery), in place of the late Sir James Paget, Bart.

Robert Koch, of Berlin, as Foreign Honorary Member in Class II., Section 4, in place of the late Louis Pasteur.

Albert Venn Dicey, of Oxford, as Foreign Honorary Member in Class III., Section 1 (Philosophy and Jurisprudence).

William Edward Hearn, of Melbourne, as Foreign Honorary

Member in Class III., Section 1, in place of the late Charles Russell, Baron Russell of Killowen.

Henry Jackson, of Cambridge, as Foreign Honorary Member in Class III., Section 2 (Philology and Archaeology), in place of the late Henry Sidgwick.

Edmondo de Amicis, of Florence, as Foreign Honorary Member in Class III., Section 4 (Literature and the Fine Arts), in place of the late John Ruskin.

On the motion of the Corresponding Secretary, it was

Voted, To meet, on adjournment, on the 10th of April next.

B. L. Robinson gave an account of " Recent Advances in the General Classification of the Flowering Plants."

R. T. Jackson spoke on " Resorption as a Factor in Growth."

The following papers were presented by title: —

The Occlusion of Magnesic Oxalate by Calcic Oxalate, and the Solubility of Calcic Oxalate. By Theodore W. Richards, Charles F. McCaffrey, and Harold Bisbee.

Contributions from the Cryptogamic Laboratory of Harvard University, XLVI. Preliminary Diagnoses of New Species of Laboulbeniaceae, III. By Roland Thaxter.

The Development and Function of Reissner's Fibre and its Cellular Connections. By Porter E. Sargent. Presented by E. L. Mark.

The Solubility of Manganous Sulphate. By Theodore W. Richards and F. R. Fraprie.

Contributions from the Gray Herbarium of Harvard University. New Series, No. XX. I. Synopsis of the genus Melampodium. II. Synopsis of the genus Nocca. III. New Species and Newly Noted Synonymy among the Spermatophytes of Mexico and Central America. By B. L. Robinson.

Contributions from the Gray Herbarium of Harvard University. New Series, No. XXI. By M. L. Fernald. Some New Spermatophytes from Mexico and Central America.

Nine hundred and twenty-fourth Meeting.

APRIL 10, 1901. — ADJOURNED STATED MEETING.

VICE-PRESIDENT TROWBRIDGE in the chair.

The Corresponding Secretary read letters from L. J. Johnson, Theodore Lyman, H. L. Smyth, and F. W. Taussig, accepting Fellowship; and from W. S. Halsted, W. W. Keen, Franklin P. Mall, E. H. Moore, Edw. L. Nichols, and Henry F. Osborn, acknowledging election as Associate Fellows.

The chair announced the following deaths: —

Edward Elbridge Salisbury, of New Haven, Associate Fellow in Class III., Section 2.

Jacob Georg Agardh, of Lund, Foreign Honorary Member in Class II., Section 2.

On the recommendation of the Rumford Committee, presented by A. G. Webster, it was

Voted, To appropriate from the income of the Rumford Fund the sum of five hundred dollars ($500) to T. W. Richards in aid of a research on the Joule-Thomson experiment on free expansion.

Edwin H. Hall presented "An Exposition of the Theory of Electrons, the Electrical Fragments of Atoms."

The following paper was presented by title: —

The Law of Physico-chemical Change. By Gilbert Newton Lewis. Presented by T. W. Richards.

Dr. W. G. Farlow was appointed Delegate of the Academy to the celebration of the ninth jubilee of the foundation of the University of Glasgow and was charged with the presentation of the address on the following page, signed by the Vice-President of Class III. and the Corresponding Secretary.

VIRO ILLUSTRISSIMO CANCELLARIO
CURIAE SENATUIQUE UNIVERSITATIS GLASGUENSIS
ACADEMIA ARTIUM ET SCIENTIARUM AMERICANA
QUAE EST BOSTONIAE NOV.-ANGLORUM.
S. P. D.

Vix dici potest quanto guadio audiverimus vos in mente habere istam diem celebrare qua Universitas vestra annum quadringentesimum expleverit, ex quo Pontifex ille benevolus nomen ac jura Universitatis concesserit; quis enim ignorat longam illam annorum seriem orbi terrarum perpetuis illuxisse virorum operibus, in omni arte atque in omni scientia praestantissimorum, nomen semper illustre Caledoniae vel ad majus fastigium efferentibus?

Quorum ut neque tempus neque charta sufficeret nominibus tantum percurrendis, nostro officio satisfiat si gratias praecipuas agentes quod ad sollemnia celebranda amicissime invitastis socium nostrum virum ornatissimum Gulielmum Gilson Farlow legaverimus qui istis caeremoniis interfuturus nostram erga vos benevolentiam pro virili parte libentissime praestabit.

Illum ergo, viri illustrissimi, precamur ut benigne excipiatis ut qui amicitiae vincula inter Scotiam Americamque arctiora dignissime ligaverit.

Dabamus Bostoniae Nov.-Anglorum A. D. Non: Maias anno salutis MCMI, atque Rerumpublicarum Foederatarum libertatis vindicatae CXXV.

A TABLE OF ATOMIC WEIGHTS

of Seventy-seven Elements.

Compiled in April, 1901, *from the most Recent Data.*

By Theodore William Richards.

Name.	Symbol.	Atomic Weight.	Name.	Symbol.	Atomic Weight.
Aluminium . .	Al	27.1	Molybdenum . .	Mo	96.0
Antimony . . .	Sb	120.0	Neodymium . .	Nd	143.6
Argon	A	39.92	Neon	Ne	19.94
Arsenic	As	75.0	Nickel	Ni	58.70
Barium	Ba	137.43	Niobium . . .	Nb = Cb	94.
Beryllium . . .	Be = Gl	9.1	Nitrogen . . .	N	14.04
Bismuth . . .	Bi	208.	Osmium . . .	Os	190.8
Boron	B	11.0	Oxygen (standard)	O	16.000
Bromine . . .	Br	79.955	Palladium . . .	Pd	106.5
Cadmium . . .	Cd	112.3	Phosphorus . .	P	31.0
Cæsium . . .	Cs	132.9	Platinum . . .	Pt	195.2
Calcium . . .	Ca	40.1	Potassium . . .	K	39.14
Carbon	C	12.001	Praseodymium .	Pr	140.5
Cerium	Ce	140.	Rhodium . . .	Rh	103.0
Chlorine . . .	Cl	35.455	Rubidium . . .	Rb	85.44
Chromium . .	Cr	52.14	Ruthenium . .	Ru	101.7
Cobalt	Co	59.00	Samarium ? . .	Sm	150.
Columbium . .	Cb = Nb	94.	Scandium . . .	Sc	44.
Copper	Cu	63.604	Selenium . . .	Se	79.2
"Didymium" .	Nd + Pr	142±	Silicon	Si	28.4
Erbium	Er	166.	Silver	Ag	107.93
Fluorine . . .	F	19.05	Sodium	Na	23.05
Gadolinium . .	Gd	156. ?	Strontium . . .	Sr	87.68
Gallium . . .	Ga	70.0	Sulphur . . .	S	32.065
Germanium . .	Ge	72.5	Tantalum . . .	Ta	183.
Glucinum . . .	Gl = Be	9.1	Tellurium . . .	Te	127.5 ?
Gold	Au	197.3	Terbium ? . . .	Tb	160.
Helium	He	3.96	Thallium . . .	Tl	204.15
Hydrogen . . .	H	1.0075	Thorium . . .	Th	233.
Indium	In	114.	Thulium ? . . .	Tu	171. ?
Iodine	I	126.85	Tin	Sn	119.0
Iridium	Ir	193.0	Titanium . . .	Ti	48.17
Iron	Fe	55.9	Tungsten . . .	W	184.
Krypton . . .	Kr	81.7	Uranium . . .	U	238.5
Lanthanum . .	La	138.5	Vanadium . . .	V	51.4
Lead	Pb	206.92	Xenon	X	128.
Lithium . . .	Li	7.03	Ytterbium . . .	Yb	173.
Magnesium . .	Mg	24.36	Yttrium . . .	Yt	89.0
Manganese . .	Mn	55.02	Zinc	Zn	65.40
Mercury . . .	Hg	200.0	Zirconium . . .	Zr	90.6

NOTE CONCERNING THE TABLE OF ATOMIC WEIGHTS.

THREE new elements are included in the table, namely, Neon, Krypton, and Xenon, discovered by Ramsay in the atmosphere. Their molecular weights cannot be considered as wholly settled, but approximate values are given in the list. There is a possibility that each of these values, as well as those given for Argon and Helium, should be halved in order to obtain the atomic weights; but for the present it seems safest to assume a monatomic molecule in each case.

Radium, the singular substance discovered by Madame Curié, is not included on account of the great uncertainty concerning its atomic weight. It is possible that some of the work upon thorium and uranium is vitiated by radium, and that the presence of this impurity may account for the inconsistencies of the data. The value given for uranium depends primarily on recent work by Richards and Merigold, as yet unpublished; but the matter cannot be considered as settled.

Attention is called to the low atomic weight of iron,* which was included without comment last year. Investigation upon this important constant is still in progress.

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* Richards and Baxter, These Proceedings, **35**, 253. (1900.)